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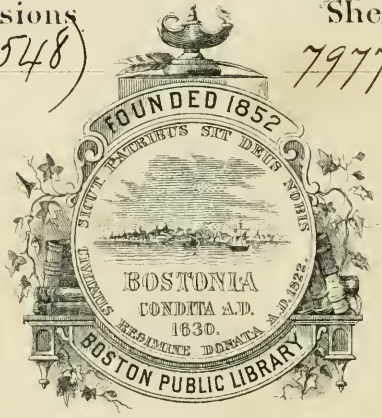

Received May 16, 1897.

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VIII.

A METHOD OF MEASURING THE ABSOLUTE SENSITIVENESS OF PHOTOGRAPHIC DRY PLATES.

By William H. Pickering.

Communicated May 14th, 1884.

Within the last few years the subject of dry plate photography has increased very rapidly, not only in general popularity, but also in importance in regard to its applications to other departments of science. Numerous plate manufacturers have sprung up in this country as well as abroad, and each naturally claims all the good qualities for his own plates. It therefore seemed desirable that some tests should be made which would determine definitely the validity of these claims, and that they should be made in such a manner that other persons using instruments similarly constructed would be able to obtain the same results.

Perhaps the most important tests needed are in regard to the sensitiveness of the plates. Most plate makers use the wet plates as their standard, giving the sensitiveness of the dry plates at from two to sixty times greater; but as wet plates vary quite as much as dry ones, depending on the collodion, condition of the bath, etc., this system is very unsatisfactory. Another method employed largely in England, depends on the use of the Warnerke sensitometer. In this instrument the light from a tablet coated with luminous paint just after being exposed to a magnesium light, is permitted to shine through a colored transparent film of graduated density upon the plate to be tested. Each degree on the film has a number, and, after a given exposure, the last number photographed on the plate represents the sensitiveness on an empirical scale. There are two or three objections to this instrument. In the first place, the light-giving power of the luminous tablet is liable to variations, and, if left in a warm, moist place, it rapidly deteriorates. Again, it has been shown by Captain Abney that plates sensitized by iodides, bromides, and chlorides, which may be equally sensitive to white light, are not equally affected by the light emitted by the paint; the bromides being much the most rapidly darkened, the chlorides next, and the iodides least of all. The instrument is

therefore applicable only to testing plates sensitized with the same salts.

In this investigation it was first shown that the plates most sensitive for one colored light were not necessarily the most so for light of another color. Therefore it was evident that the sun must be used as the ultimate source of light, and it was concluded to employ the light reflected from the sky near the zenith as the direct source. But as this would vary in brilliancy from day to day, it was necessary to use some method which would avoid the employment of an absolute standard of light. It is evident that we may escape the use of this troublesome standard, if we can obtain some material which has a perfectly uniform sensitiveness. For we may then state the sensitiveness of our plates in terms of this substance, regardless of the brilliancy of our source. The first material tried was white filter paper, salted, and sensitized in a standard solution of silver nitrate. This was afterward replaced by powdered silver chloride, chemically pure, — which was found to be much more sensitive than that made from the commercial chemicals. This powder is spread out in a thin layer, in a long paper cell, on a strip of glass. The cell measures one centimeter broad by ten in length. Over this is laid a sheet of tissue paper, and above that a narrow strip of black paper, so arranged as to cover the chloride for its full length and half its breadth. These two pieces of paper are pasted on to the under side of a narrow strip of glass which is placed on top of the paper cell. The apparatus in which the exposures are made consists of a box a little over a meter in length, closed at the top by a board, in which is a circular aperture 15.8 cm. in diameter. Over this board may be placed a cover, in the centre of which is a hole .05 cm. in diameter, which therefore lets through .00001 as much light as the full aperture. The silver chloride is placed at a distance of just one meter from the larger aperture, and over it is placed the photographic scale; which might be made of tinted gelatines, or, as in the present case, constructed of long strips of tissue paper, of varying widths, and arranged like a flight of steps; so that the light passing through one side of the scale traverses nine strips of paper, while that through the other side traverses only one strip. Each strip cuts off about one sixth of the light passing through it, so that, taking the middle strip as unity, the strips on either side taken in order will transmit approximately, —

1	2	3	4	5	6	7	8	9
2.0	1.65	1.4	1.2	1.0	.85	.7	.6	.5

The instrument is now pointed toward the zenith for about eight minutes, on a day when there is a bright blue sky. On taking the apparatus into the dark room, and viewing the impression by gas-light, it will be found that the markings, which are quite clear at one end, have entirely faded out by the time the middle division is reached. The last division clearly marked is noted. Five strips cut from sensitized glass plates, ten centimeters long and two and a half in width, are now placed side by side under the scale, in the place of the chloride. By this means we can test, if we wish, five different kinds of plates at once. The cover of the sensitometer containing the .05 cm. hole is put on, and the plates exposed to sky light for a time varying anywhere between twenty seconds and three minutes, depending on the sensitiveness of the plates. The instrument is then removed to the dark room, and the plates developed by immersing them all at once in a solution consisting of four parts potassium oxalate, and one part ferrous sulphate. After ten minutes they are removed, fixed, and dried. Their readings are then noted, and compared with those obtained with the silver chloride. The chloride experiment is again performed as soon as the plates have been removed, and the first result confirmed. With some plates it is necessary to make two or three trials before the right exposure can be found, but if the image disappears anywhere between the second and eighth divisions, a satisfactory result may be obtained.

The plates were also tested using gas-light instead of daylight. In this case an argand burner was employed, burning 5 cu. ft. of gas per hour. A diaphragm 1 cm. in diameter was placed close to the glass chimney, and the chloride was placed at 10 cm. distance, and exposed to the light coming from the brightest part of the flame, for ten hours. This produced an impression as far as the third division of the scale. The plates were exposed in the sensitometer as usual, except that it was found convenient in several cases to use a larger stop, measuring .316 cm. in diameter.

The following table gives the absolute sensitiveness of several of the best-known kinds of American and foreign plates, when developed with oxalate, in terms of pure silver chloride taken as a standard. As the numbers would be very large, however, if the chloride were taken as a unit, it was thought better to give them in even hundred thousands.

SENSITIVENESS OF PLATES.

Plates.	Daylight.	Gas-light.
Carbutt Transparency	.7	
Allen and Rowell	1.3	150
Richardson standard	1.3	10
Marshall and Blair	2.7	140
Blair Instantaneous	3.0	140
Carbutt Special	4.0	20
Monroe	4.0	25
Wratten and Wainwright	4.0	10
Eastman Special	5.3	30
Richardson Instantaneous	5.3	20
Walker Reid and Inglis	11.	600
Edwards	11.	20
Monckhoven	16.	120
Beebe	16.	20
Cramer	16.	120

It will be noted that the plates most sensitive to gas-light are by no means necessarily the most sensitive to daylight; in several instances, in fact, the reverse seems to be true.

It should be said that the above figures cannot be considered final until each plate has been tested separately with its own developer, as this would undoubtedly have some influence on the final result.

Meanwhile two or three interesting investigations naturally suggest themselves: to determine, for instance, the relative actinism of blue sky, haze, and clouds; also, the relative exposures proper to give at different hours of the day, at different seasons of the year, and in different countries. A somewhat prolonged research would indicate what effect the presence of sun-spots had on solar radiation, — whether it was increased or diminished.

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